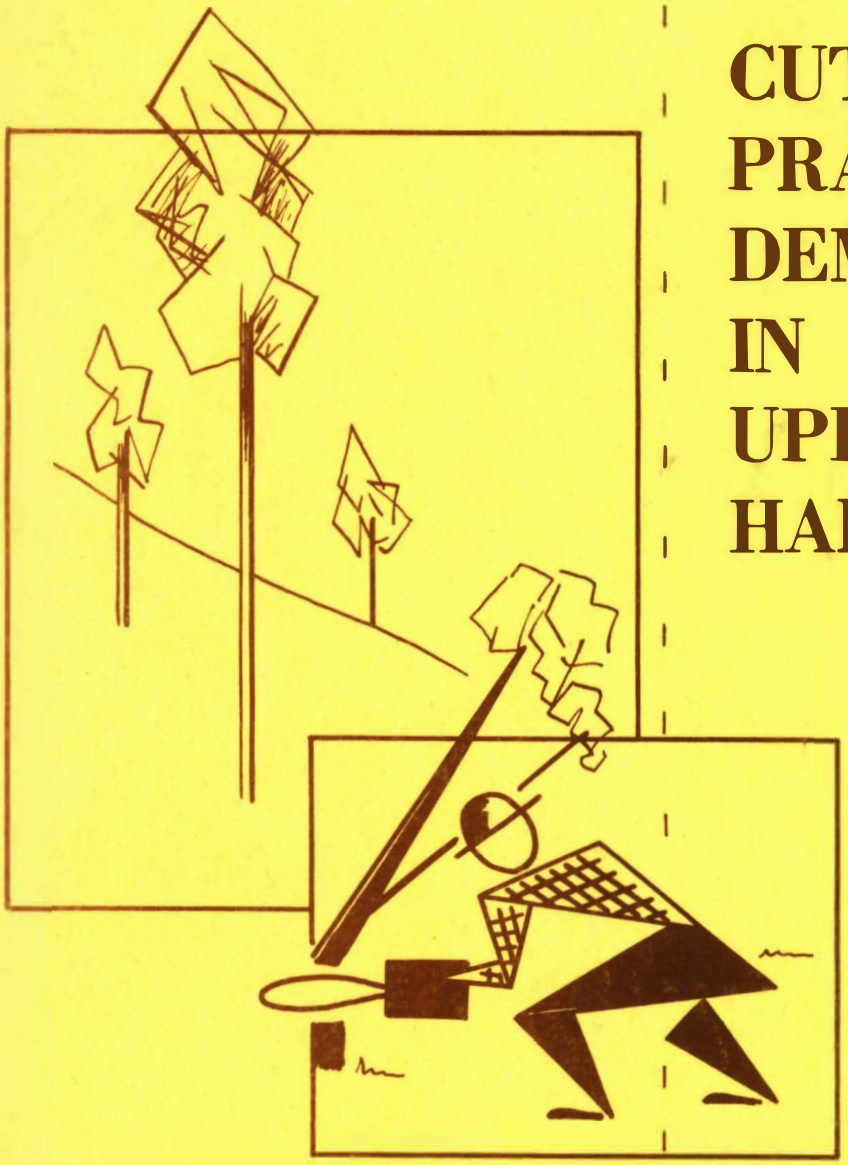

CUTTING PRACTICE DEMONSTRATIONS IN UPLAND HARDWOODS

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CUTTING PRACTICE DEMONSTRATIONS IN UPLAND HARDWOODS

A demonstration of three intensities of forest management on two forest sites was established in 1948 on the Kaskaskia Experimental Forest in southern Illinois. The chief purpose was to show timberland owners in the area how cutting by these methods affected stand development and the immediate and future timber yields. By 1956, significant growth changes had begun to show up. These 8-year trends are described here.

DESCRIPTION OF THE DEMONSTRATION WOODLANDS

The demonstration areas were typical of unmanaged woodlands in southern Illinois. Such stands contain many culls and low-quality trees, and a high percentage of undesirable species. Growth is usually slow, about 150 board feet per acre per year on better sites and about half that on poorer sites.[1/]

The demonstration was conducted on the two most common topographic sites in the area. The poorer site (oak-hickory) commonly occupies the southerly and westerly slopes and ridgetops. On these sites the better tree species are white oak (Quercus alba L.), black oak (Q. velutina Lam.), southern red oak (Q. falcata Michx.), scarlet oak (Q. coccinea Muenchh.), hickories (Carya), and post oak (Q. stellata Wangenh.).

The better sites are the coves and the middle and lower northerly and easterly slopes. These are called mixed-hardwood sites and contain yellow-poplar (Liriodendron tulipifera L.), white oak, northern red oak (Q. rubra L.), black oak, southern red oak, scarlet oak, white ash (Fraxinus americana L.), and hickories.

1/ Minckler, Leon S., Fassnacht, Donald L., and Train, Robert K. Growth and species evaluation of some unmanaged upland hardwoods in southern Illinois. Cent. States Forest Expt. Sta. Tech. Paper 110, 8 pp., illus. 1948.

DESCRIPTION OF THE THREE TYPES OF CUTTING

Rehabilitation Cut

Two stands, one on each site, were selectively cut leaving only the good growing-stock trees in the residual stand. Because the original stand was in poor condition, this first cut actually was a heavy rehabilitation cut (fig. 1). After the harvest and improvement cut of merchantable trees, the cull trees and the undesirable pole-size trees were girdled. A second girdling was made in 1952 to remove defective ingrowth and trees damaged by a severe ice storm.

Merchantability standards for sawtimber-size trees were based on utilization practices common to southern Illinois. Standards were assigned to each species or species group and varied by the minimum top diameter and the acceptable percentage of cull in the logs. A sawtimber-size tree was classified as a cull and eliminated if, because of defect, cull, or poor form, it did not contain one merchantable, 12-foot log. Desirability standards for pole-size trees were based upon species, defect, and general tree form. Trees less than 4.6 inches were not considered.

Figure 1.--The mixed hardwood rehabilitation demonstration area in 1948 before treatment. The trees in the foreground, later removed by cutting and girdling, are shown by "X" marks.

Figure 2.--Cove on the mixed-hardwood heavy commercial cut demonstration area taken in 1948 before cutting.

Heavy Commercial Cut

In the mixed-hardwood stand, all merchantable sawtimber trees were cut except 15 of the best 11- to 17-inch trees per acre (fig. 2). In the oak-hickory stand all merchantable sawtimber trees were cut except 10 of the best 11- to 17-inch trees per acre. No pole-size trees were cut. This system is a slight modification of the minimum-cutting-practice rules proposed by Region 9 of the U. S. Forest Service for upland mixed-hardwood and oak-hickory forest types. The chief differences between this and the rehabilitation cut were that in this cut more of the sawtimber was cut and cull trees were not killed.

Merchantability-Limit Cut

One stand on each site was cut as if immediate profit were the only consideration. At the time of cutting there was a market for sawlogs, mine props, and mine ties. Therefore, the first cut removed nearly all sound trees 5 inches d.b.h. and larger. All culls were left and no stand improvement was done.

RESULTS AFTER 8 YEARS[2/]

Volume Growth

When both quality and growth of the residual stands are considered, the rehabilitation in the mixed-hardwood stand was the most successful treatment (fig. 3). After cutting 2,200 board feet per acre, the volume increased from 2,000 to an average of 4,700 board feet per acre in the 8-year period. This was an average annual increase of 335 board feet per acre. Thus, the stand more than doubled in volume in 8 years and the average quality of the stand was increased.

The oak-hickory stand that had the rehabilitation treatment also doubled in volume in 8 years (fig. 4). Proportionately, the volume cut was the same as in the mixed-hardwood stand. However, on this site the original stand volume was only 2,700 board feet per acre and cutting reduced it to 1,300 board feet per acre. After 8 years the volume per acre was 3,000 board feet, an annual increase of 213 board feet per acre each year on good growing stock.

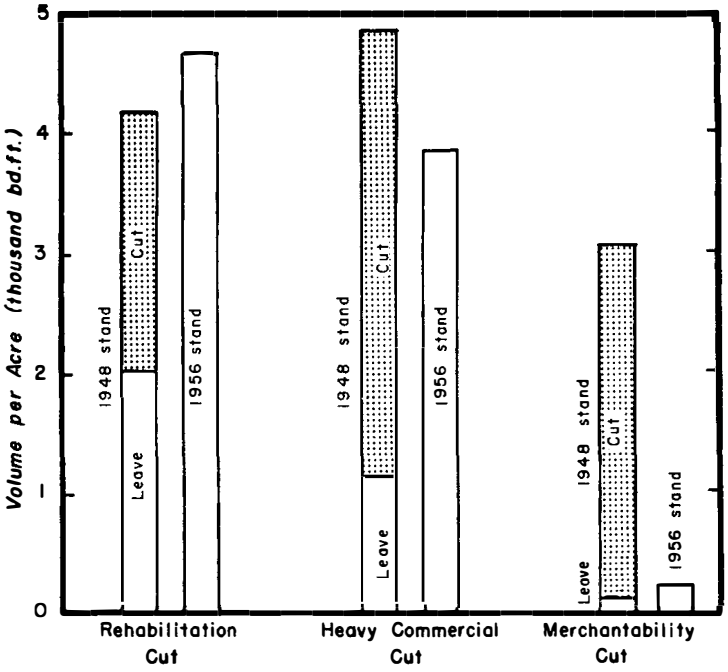

Figure 3.--Volume of original, residual, and present stand: Mixed-hardwood site.

2/ See Appendix (tables 2 through 4) for detailed data of original, residual, and present stands by diameter classes.

The stands that had the heavy commercial cut also more than doubled in volume in the 8-year period, but in these stands a part of the growth was made on low-quality trees. On the mixed-hardwood site, where 3,700 board feet per acre were cut, the residual stand increased from 1,200 board feet per acre to 3,900 board feet, a growth rate of 338 board feet per acre each year. On the oak-hickory site, where the cut reduced the volume from 1,800 to 750 board feet per acre, the volume increased to 2,000 board feet per acre at an average rate of 162 board feet each year.

The merchantability cut left only 163 board feet per acre on the mixed-hardwood site and no sawtimber on the oak-hickory site. The average volume per acre was only 264 board feet in the mixed-hardwood stand and only 75 board feet per acre in the oak-hickory stand after 8 years.

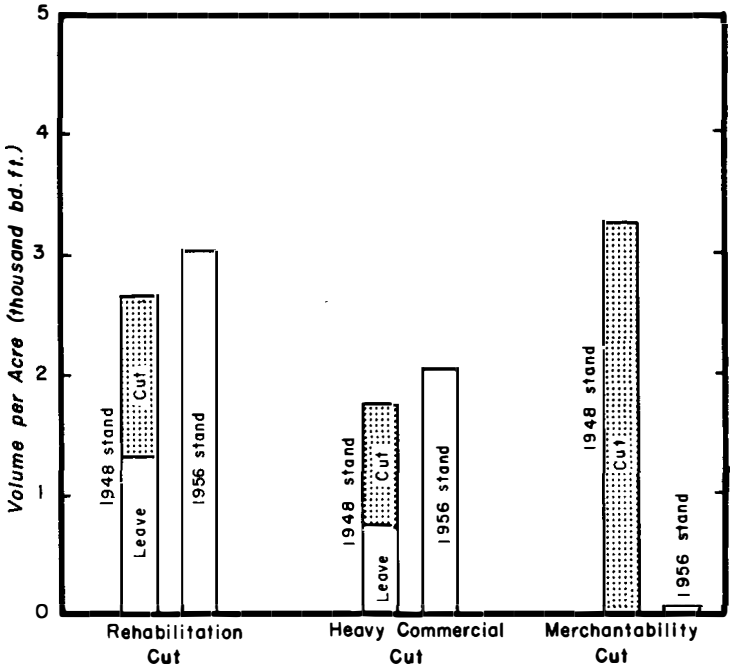

Figure 4.--Volume of original, residual, and present stand: Oak-hickory site.

Basal-Area Growth

The most significant basal-area changes also occurred in the stands where the rehabilitation cuts were made, even though these stands did not show the greatest net basal-area increase. In the mixed-hardwood stand the basal area of the original stand was reduced from 78 to 48 square feet per acre by cutting merchantable and killing cull trees (fig. 5). Four years later additional cull trees containing 14 square feet of basal area per acre were killed. Even so the basal area at the end of the 8-year period was 57 square feet per acre, a net increase of 9.

An even greater net basal-area increase occurred on the oak-hickory site (fig. 6). There the cutting and cull-killing treatment reduced the original basal area from 70 to 43 square feet per acre at the start of the 8-year period. In 1952 trees containing an additional 13 square feet of basal area were killed, yet at the end of the period there were 58 square feet per acre, a net increase of 15.

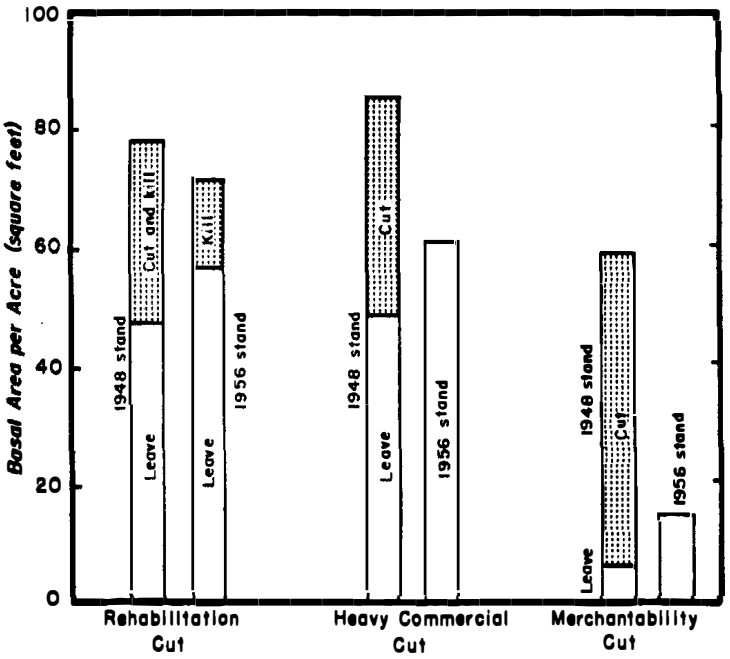

Figure 5.--Basal area of original, residual, and present stand: Mixed-hardwood site.

In the mixed-hardwood stand, where the heavy commercial cuts were made, basal area was reduced from 86 to 48 square feet per acre. In the oak-hickory stand the basal area was reduced from 57 to 42 square feet per acre. In the mixed-hardwood stand the basal area per acre after 8 years was 62 square feet, and in the oak-hickory it was 61. The net increases were 13 and 19 square feet per acre, respectively. However, much of the increase in the two stands was due to the diameter growth of cull and undesirable trees and thus is not as important as the somewhat smaller basal-area increases made in the stands that had a rehabilitation cut.

The merchantability cuts almost eliminated the basal area on the two sites. On the mixed-hardwood site basal area was reduced from 60 to a little more than 6 square feet per acre. On the oak-hickory site cutting reduced basal area per acre from 63 to 9 square feet. In the 8-year period basal area per acre on both sites increased by about 100 percent. More than half of the trees on both sites, however, are less than 8 inches d.b.h. and most of the larger ones are culls or undesirable species.

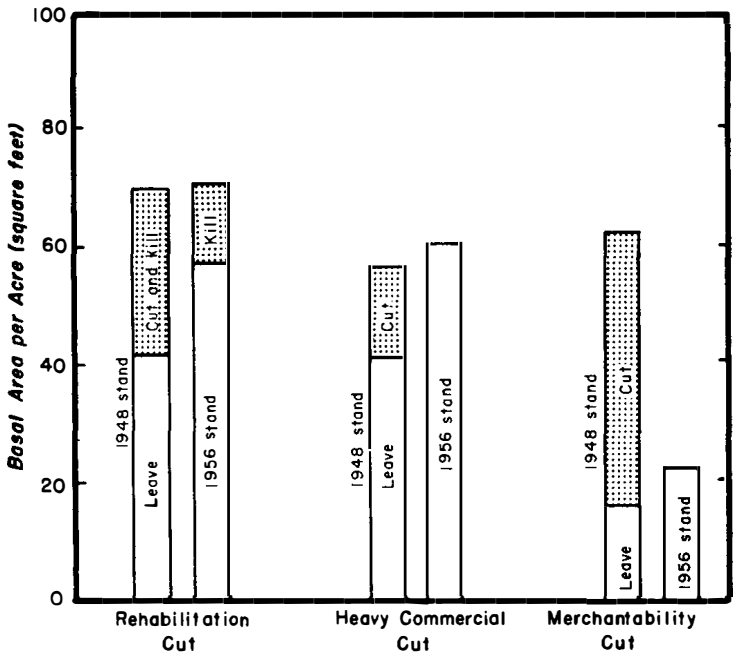

Figure 6.--Basal area of original, residual, and present stand: Oak-hickory site.

Changes in Composition and Tree Quality

The most favorable change in composition and quality also occurred in the stands where the rehabilitation cuts were made (table 1). Most noticeable change was a reduction in the number of undesirable trees in the mixed-hardwood stand. Here there was a 73-percent reduction in numbers of hard maple, beech, elm, dogwood, and sassafras, none of which is an important timber species in the study area. In the oak-hickory stand also, a number of undesirable trees were eliminated, but another significant change there was that reproduction of desirable species became established in the openings created by cutting and killing trees. Most of the reproduction that became established in the openings of the mixed-hardwood stand was also of desirable composition. Thus, the rehabilitation cut improved quality and composition of the residual stands and favorably affected the composition of new reproduction.

The heavy commercial cut had a negative effect on composition of the residual stand although reproduction in the openings was as good as for the rehabilitation treatment. After the merchantable trees were cut, the proportion of undesirable pole-size trees was greater and did not change during the 8-year period. In fact some of the growth in this stand occurred on undesirable trees because they were released by the cut that was made.

Table 1.--Number of cull trees per acre by diameter class and treatment, 1956

Diameter class	Rehabilitation cut	Heavy commercial	Merchantability limit
	Mixed-hardwood site		
5-10	0	30	23
11-16	0	1	1
17+	0	0	0
	Oak-hickory site		
5-10	0	28	27
11-16	0	4	3
17+	0	2	2

The merchantability cut also stimulated the establishment and growth of reproduction (fig. 7). However, the effects were somewhat different on the two sites. Eight years after cutting only about a third of the saplings in the mixed-hardwood stands were desirable species. But in the oak-hickory stands nearly two-thirds of the sapling stems were desirable species.

DISCUSSION

Although these demonstration plots are unreplicated within sites, the results from the rehabilitation treatment on the two sites were sufficiently similar and favorable to recommend it over the other two.

After 8 years it is plain that initial elimination of cull and other undesirable trees is necessary for best results. Unless this is done, cutting will stimulate the growth of undesirable trees that have low potential value. These undesirable trees increase in diameter and volume and occupy space that could be utilized by desirable trees.

Figure 7.--Typical dense condition of reproduction 8 years after the merchantability-limit cut in oak-hickory.

Furthermore, cutting mature and low-quality trees and killing cull trees will create openings for the establishment of new reproduction. Because many unmanaged stands are understocked after an initial cut is made, it is desirable to get reproduction as soon as possible.

A woodland owner who has an unmanaged stand of hardwoods should begin his management by marking the mature and low-quality merchantable trees and the culls. As soon as the merchantable trees are felled, he should kill the remaining marked trees and those that may have been damaged by logging. (We have found that a most effective killing treatment is to make a continuous frill around the base of the tree with an ax and apply an oil solution of 2,4,5-T in the frill.)

The greatest disadvantage with the heavy commercial cut was that the residual stand contained so many cull and undesirable trees. The benefits of cutting were shared by these trees as well as the future sawtimber trees. Growth in these plots is further evidence that cutting mature trees on both good and poor sites will stimulate diameter growth of the remaining trees. However, there is no merit in stimulating growth on trees that have little or no future value, expecially when it is possible to replace these trees with desirable reproduction.

There is not much that can be said so far in favor of the merchantability cut. It should only be used when most of the trees are of very low quality and markets are available for disposing of them. Even in these cases, clear cuts should not be made in blocks larger than 2 or 3 acres if seeding from adjacent stands is required. Areas so cut cannot be expected to produce sawtimber-size trees in less than 60 to 80 years and it may also be necessary to treat the stand several times to eliminate undesirable trees that are likely to become established.

APPENDIX

Table 2.--Volume of original, residual, and present stand

(Board feet per acre)

MIXED-HARDWOOD SITE

D.b.h. class	Rehabilitation			Heavy commercial			Merchantability limit		
	1948 Original	1948 Residual	1956 Present	1948 Original	1948 Residual	1956 Present	1948 Original	1948 Residual	1956 Present
11-13	1469	980	1793	1878	975	1599	1386	163	148
14-16	1331	741	1568	1566	225	1485	1210	---	116
17-19	898	306	884	806	---	735	455	---	---
20-22	313	---	459	385	---	86	171	---	---
23-25	195	---	---	286	---	---	---	---	---
Total	4206	2027	4704	4921	1200	3905	3222	163	264
Cut	2179			3721			3059		
Change			+2677			+2705			+101

OAK-HICKORY SITE

11-13	867	663	1109	627	492	884	955	---	75
14-16	658	398	1366	929	246	700	1054	---	---
17-19	657	254	373	214	---	448	875	---	---
20-22	265	---	172	---	---	---	143	---	---
23-25	210	---	---	---	---	---	250	---	---
Total	2657	1315	3020	1770	738	2032	3277	---	75
Cut	1342			1032			3277		
Change			+1705			+1294			+75

Table 3.--Number of trees in original, residual, and present stands

(Number of trees per acre)

MIXED-HARDWOOD TYPE

D.b.h class	Rehabilitation			Heavy commercial[1]			Merchantability limit[1]		
	1948	1948	1956	1948	1948	1956	1948	1948	1956
	Original	Residual	Present	Original	Residual	Present	Original	Residual	Present
5-7	74	57	23	87	87	53	58	14	26
8-10	45	35	22	46	46	42	34	4	12
11-13	24	15	22	28	14	21	21	3	5
14-16	10	6	10	13	2	10	10	-	1
17-19	5	1	5	4	-	2+	2	-	-
20-22	1	-	2	2	-	1-	1	-	-
23-25	1	-	-	1	-	-	-	-	-
Total	160	114	84	181	149	129	126	21	44
Cut and killed	46			32			105		
Change			-30			-20			+23

OAK-HICKORY SITE

5-7	82	72	68	78	78	81	58	37	52
8-10	39	36	42	34	34	36	19	6	15
11-13	18	12	18	13	9	17	17	2	2
14-16	7	5	11	10	2	7	12	2	2
17-19	5	1	2	2	1	4	5	--	2
20-22	1	--	1	--	--	--	1	--	--
23-25	1	--	--	1	1	1	1	--	--
Total	153	126	142	138	125	146	113	47	73
Cut	27			13			66		
Change			+16			+21			+26

1/ Numbers of trees include culls.

Table 4.--Basal area of original, residual, and present stand

MIXED-HARDWOOD SITE

D.b.h. class	Rehabilitation			Heavy commercial[1]			Merchantability cut[1]		
	1948	1948	1956	1948	1948	1956	1948	1948	1956
	Original	Residual	Present	Original	Residual	Present	Original	Residual	Present
5-7	14.4	11.2	4.7	16.0	16.0	10.6	11.2	2.7	4.8
8-10	19.9	15.7	9.7	19.9	19.9	18.2	14.3	1.6	4.7
11-13	18.2	11.6	17.9	21.3	10.6	16.9	16.9	2.2	3.8
14-16	12.6	7.1	12.6	15.1	1.8	11.4	11.8	---	1.2
17-19	8.3	2.4	8.4	7.3	----	4.1	3.9	---	---
20-22	3.2	---	3.7	4.0	---	0.5	1.6	---	---
23-25	1.8	---	---	2.4	---	---	---	---	---
Total	78.4	48.0	57.0	86.0	48.3	61.7	59.7	6.5	14.5
Cut or kill	30.4		---	37.7		---	53.2		---
Change			+9.0			+13.4			+8.0

OAK-HICKORY SITE

5-7	15.5	13.2	11.0	13.7	13.7	15.2	11.2	2.7	4.8
8-10	16.7	15.3	17.0	14.6	14.6	15.6	14.3	1.6	4.7
11-13	14.0	6.6	13.2	9.7	7.3	12.6	16.9	2.2	1.8
14-16	8.4	5.8	12.5	12.6	2.8	8.5	11.8	2.3	2.4
17-19	9.4	1.9	3.1	4.4	1.4	6.6	3.9	---	3.6
20-22	2.8	---	1.3	---	---	---	1.6	---	---
23-25	3.5	---	---	2.3	2.3	2.5	3.4	---	---
Total	70.3	42.8	58.1	57.3	42.1	61.0	63.1	8.8	17.3
Cut or killed	27.5			15.2			54.3		
Change			+15.3			+18.9			+8.5

1/ Basal area includes culls

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